DEPARTMENT OF THE ARMY
ARMY CONCEPT TEAM IN VIETNAM
APO San Francisco 96384

AVIB-GCD

12 MAR 1970

SUBJECT: Final Letter Report - Ground Illumination Signals XM191, XM192, XM193

Commanding General
United States Army, Vietnam
ATTN: AVHGC-DST
APO 96375

1. REFERENCES

a. Message, 79501, AVHGC-DST, Headquarters USARV, 28 August 1969, subject: Mini-Grenade, Signal Illuminator.

b. Disposition Form, AVHGC-DST, Headquarters USARV, 5 September 1969, subject: Mini-Grenade, Signal Illuminator.

c. Letter, CRDLWL-9C, USA Land Warfare Laboratory, 23 September 1969, subject: Mini-Grenade Munitions, LWL Task 05-C-69.

d. Draft Equipment Publication 9-1307-404-12 (PA-DC5), Picatinny Arsenal, July 1969, subject: Operator and Organizational Maintenance For Signal, Illuminator, Ground: Yellow, XM191; Green, XM192; Red, XM193.

e. Evaluation Plan, AVIB-GCD, Army Concept Team In Vietnam, 22 September 1969, subject: Ground Illumination Signal XM191, XM192, XM193.

2. PURPOSE

To determine the suitability of the Ground Illumination Signal XM191, XM192, and XM193 in the combat environment of the Republic of Vietnam (RVN).

3. OBJECTIVES

a. Objective 1. To evaluate operational performance of the ground illumination signal when employed as a signaling device.

b. Objective 2. To determine acceptability of the ground illumination signal when used as a means of marking positions for aviation elements.

4. BACKGROUND

The US Army is developing several series of mini-grenades (pocket-size munitions) for combat use in RVN. These small, lightweight items

are designed to supplement the standard munitions and enable a soldier to carry a greater variety of munitions without an increase in weight. These pocket-size munitions include flare, thermite, white phosphorous, CS, and smoke munitions. The ground illumination signals were sent to RVN as part of the developmental effort.

5. DESCRIPTION

a. The ground illumination signal is available in three colors: yellow (XM191), green (XM192), and red (XM193). The cap of the grenade is the color of the signal, and also identifies the color of the signal with a raised letter Y, G, or R. Immediately below the cap, the letter C is printed three times in the same color as the illuminant. Six signals of the same color are packaged lengthwise (2 rows of 3 signals each) in a barrier material packing bag, along with an instruction sheet.

b. Each ground illumination signal consists of a cylindrical illuminant pellet, with an igniting first-fire mixture at one end, pressed into a cardboard case. The fuze is ignitacord wrapped with a heat-shrinkable tubing and is coiled at the first-fire end of the illuminant pellet. The pellet and fuze are loaded into a plastic container. The complete item is 1.8 inches in height, 1.3 inches in diameter, and weighs approximately 2 ounces (see accompanying figure).

c. The signal is ignited by removing the safety clip and pulling the pull ring, which draws the coated pull wire through an ignition composition. The resultant friction ignites the fuze. Within 2 to 5 seconds the illuminating pellet is ignited.

d. The red and yellow signals burn for approximately 70 seconds (red or yellow); the green signal burns for approximately 40 seconds. In the absence of competing light sources, the signals are visible on a clear night at a slant range of 1500 meters from aircraft flying at an altitude of 300 meters.

6. METHOD OF EVALUATION

a. Approach

A 60-day evaluation of the ground illumination signal was conducted by units of the following divisions during the period 1 November to 31 December 1969:

1st Cavalry Division (Airmobile)
101st Airborne Division (Airmobile)
Americal Division
25th Infantry Division[1]

1. Participated for 30 days.

The divisions taking part in the evaluation were issued 240 signals of each color. The ACTIV project officer instructed the units on the operation of the signal and the objectives of the evaluation. One project officer from each division assisted in the orientation and data-gathering phases of the evaluation.

b. Data Collection

Data were derived from:

(1) Questionnaires completed by individuals and using units.

(2) Interviews with users or their commanders.

(3) Reports submitted by battalion and larger organizations participating in the evaluation.

(4) Personal observations of the ACTIV project officer.

c. Environment

The evaluating units operated in the I and III Corps Tactical Zones of RVN. These zones include portions of the Mekong Delta and Mekong Terrace regions, the Northeast Coastlands, and the Northern Highlands. These zones provided a good representation of terrain and vegetation conditions existing in RVN. The delta and terrace regions of III Corps Tactical Zone are predominantly regions of flat terrain, savanna, swamp, and rice paddy with generally good-to-excellent vertical and horizontal visibility characteristics. However, there are sizable areas of secondary jungle that seriously limit horizontal visibility. The Northeast Coastlands, extending northward from about the mid-point to the northern boundary of the country, are an intensively cultivated series of coastal valleys with excellent visibility features. Westward from the coast, low brushwood-covered hills merge into the foothills of the Annamite Mountain chain until multi-canopy rain forest, where vertical visibility is totally obscured, is predominant. The Northern Highlands are almost entirely forested, relieved only by occasional savanna or deforested areas. The evaluation period extended through the transition from the southwest to the northeast monsoon seasons. The delta and terrace regions experienced steadily improving weather conditions with generally good day and night flying conditions. The Northeast Coastlands and Northern Highlands, however, had increasing rain and fog, which frequently limited or precluded tactical aerial operations.

7. OBJECTIVE 1. TO EVALUATE THE OPERATIONAL PERFORMANCE OF THE GROUND ILLUMINATION SIGNALS WHEN EMPLOYED AS A SIGNALING DEVICE

a. Visibility To Aircraft

Under prevailing clear weather conditions in the south, the essential criterion of visibility to aircraft at slant ranges up to 1500 meters

was met or exceeded in all reported instances. A major unit, while experimenting with the signals as a method of marking the defensive perimeter for supporting gunships, reported that the signals were readily identifiable and distinguishable as to color to gunships orbiting at approximately 700 feet above ground level (AGL) and 1 kilometer distance. In other instances the signals were identified from an approximate distance of 2 nautical miles at 1500 feet AGL. Adverse weather conditions prevailing in the Northeast Coastal and mountain regions severely limited visibility. However, one company commander stated: "In the night, two (red grenades) were used to bring in a dustoff (medical evacuation) helicopter under poorest weather conditions." Distance from the landing zone was unspecified. Another report stated visibility for a yellow signal to be 1 kilometer under cloudy and light-rain conditions. In both instances, the terrain was flat and open. As expected, heavy jungle canopy limited the utility of the signal. Long range reconnaissance patrol personnel stated that, under these circumstances, the signal was useless; the situation demanded a rocket or other canopy-penetrating type of signal. In another case, eight signals were required for a medical evacuation mission in a double-canopy forest environment. No preferences were stated by users with respect to color.

b. Ease of Operation

Preparation of the signals for use was found to be simple and straightforward. Removal of the safety clips and ignition of the signal under conditions of darkness was readily accomplished. All respondents stated that the color of the signals could be determined in darkness by the raised letter on the plastic cap. Except as noted in Paragraph d, below, the fuze ignited the signal within the rated 2 to 5 seconds.

c. Burning Time

The observed burning times were reported, in nearly all cases, to correspond to the rated periods of 40 seconds for green and 70 seconds for red and yellow signals. On almost all resupply or medical evacuation missions, use of one to four signals proved adequate to guide an aircraft to the landing zone.

d. Reliability

During the course of the evaluation an excessively high overall dud rate of 26 percent was experienced by the using organizations. The following table summarizes the reported experiences of the four divisions:

	Signals Initiated	Duds
101st Airborne Division (Airmobile)	36	8
1st Cavalry Division (Airmobile)	102	26
25th Infantry Division	36	10
Americal Division	75	21
Totals	249	65

The major cause of duds was separation of the ultrasonically sealed cap from the housing of the signal prior to ignition of the burning composition. The frequency of this malfunction was found to be a function of the distance the signal was thrown. Signals impacting on hard surfaces such as the compacted laterite soil common in Vietnam malfunctioned at a rate as high as 50 percent. Some signals were observed to lose both the ignition element and the illumination pellet on impact. When the adverse effect of tossing or throwing the signal was recognized, and instructions were given to place the signal on the ground, or limit throwing it to a few feet, the dud rate dropped below 10 percent. A few other malfunctions, such as breakage of the pull-wire or loss of the ignition cup assembly, occurred on a random basis with neither a pattern nor significant frequency. No malfunctions during the 60-day evaluation period could be attributed to deterioration due to exposure to humidity or moisture.

8. OBJECTIVE 2: TO DETERMINE THE ACCEPTABILITY OF THE GROUND ILLUMINATION SIGNAL WHEN USED AS A MEANS OF MARKING GROUND POSITIONS FOR LOCATION BY AVIATION ELEMENTS

a. Preference for the Ground Illumination Signal

(1) Users investigated a variety of tactical roles for the ground illumination signals. Preferences expressed were usually dependent upon the capability of the signal to meet the requirements of specific types of missions and its reliability. Combat employments of the signal included:

(a) Medical evacuations.

(b) Resupply.

(c) Extraction of units from landing zones (LZs).

(d) Marking of unit positions.

The governing factors in each situation were the physical environment, the tactical situation, and the performance parameters of the signal.

(2) In most instances the ground illumination signal proved to be a highly suitable signaling device for medical evacuation and resupply missions. The signal possessed advantages over the railroad warning fusees with respect to increased durability and convenience in transporting it under field conditions. The size and packaging permitted adequate distribution of the signals among leaders or communications personnel to meet the anticipated usage. For medical evacuation and resupply missions, burning time and visibility to aircraft were satisfactory for nearly all environmental conditions, except under heavy jungle canopy. Only one occasion was reported in which the light produced by the signal resulted in compromise of the tactical operation at an ambush location. In this employment, directional stroboscopic lights were preferred.

(3) Long range reconnaissance patrols (LRRP) personnel employed the ground illumination signals and found them to be unsuitable for their purposes for two reasons: possible disclosure of friendly positions and lack of impact durability. In situations where security of the LRRP was a paramount consideration, the stroboscopic light was preferred because the operator could control the duration and direction of the light emission. Also, the need to throw the signal to avoid disclosure of own position was inhibited by the low impact durability of the fuzing system.

(4) The signal's fragility, combined with its relatively short burning time, also limited its application as a perimeter marking device. Front line trace markers, railroad warning fusees, and trip flares, with their longer burning times, proved to be more suitable in this role.

b. Safety

The 2-to-5 second delay in the ignition train was inadequate to permit throwing the signal an appreciable distance safely. Because the fuze starts to function immediately after the friction wire is pulled, hesitation resulted in the signal igniting in the user's hand or in close proximity to it. Six instances of minor burns resulting from attempts to throw the signals were reported. No safety problems were encountered in transportation or storage of the ground illumination signals.

c. Employment Technique

The operator and organizational maintenance manual prescribes the procedure for employment of the signal. Specifically, the manual states that the signal should be placed on the ground or tossed. Human nature and the common term "mini-grenade" encouraged the natural tendency to throw the signal, contrary to the required employment technique. Because of the design, the required employment technique proved too restrictive and was considered unacceptable to most users.

d. Acceptability

The consensus of the personnel involved in the evaluation was that the signal would be acceptable for operational use in the combat environment of RVN if the impact durability and the safety of the fuzing system could be improved.

9. CONCLUSIONS

It is concluded that:

a. The signals were readily visible to aircraft at slant ranges greater than 1500 meters on a clear night.

b. Identification of the signal color and preparation for use under conditions of darkness was easy.

c. In most instances, the burning times were sufficient to accomplish the signaling mission.

d. The signals were unreliable if thrown more than a few meters onto hard dirt surfaces.

e. Light weight and ready availability of the signals as a light source favored its acceptability.

f. The 2-to-5 second delay in the fuze functioning sequence was too brief to permit throwing the signal safely.

g. Evaluating organizations generally stated that the signals were suitable for use in RVN, if the impact durability and fuze design could be improved.

10. RECOMMENDATIONS

It is recommended that:

a. The ground illumination signals in their present configuration not be procured.

b. The design of the signal be modified to provide for:

(1) Incorporation of a positive safety device to prevent ignition until the signal is released from the user's hand.

(2) Reliable ignition when thrown.

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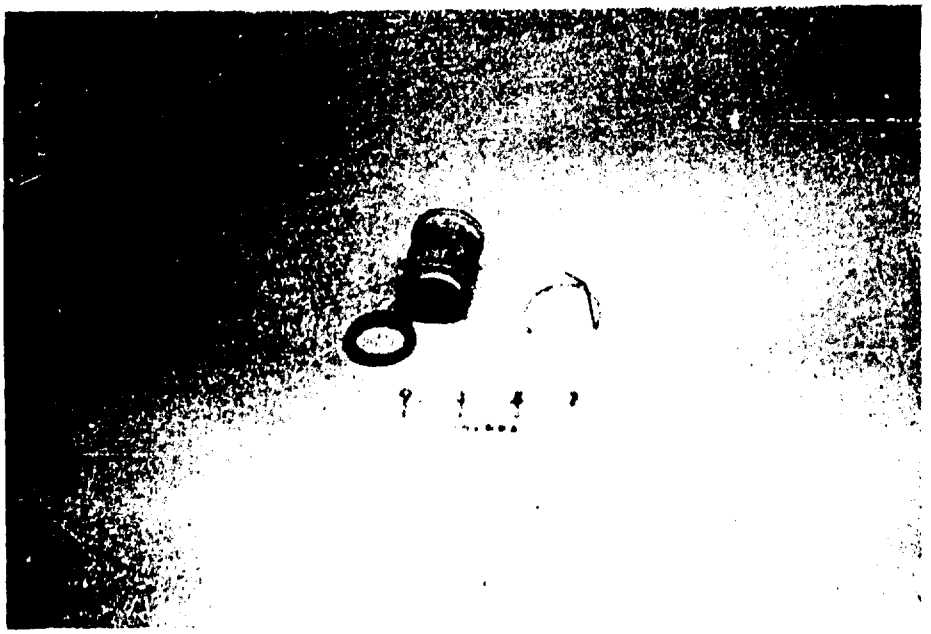

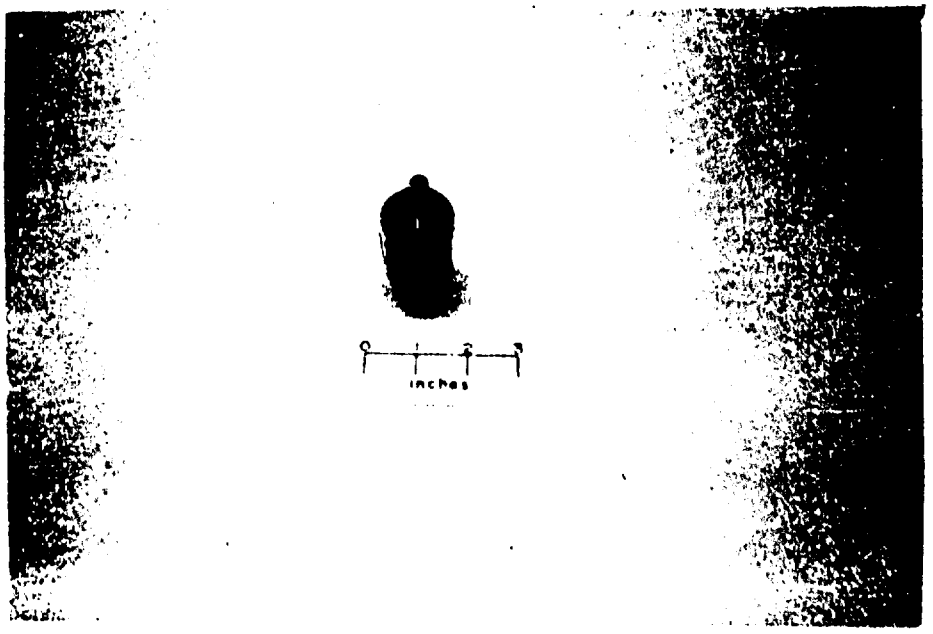

Ground Illumination Signal

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13. ABSTRACT

The Army Concept Team in Vietnam evaluated the XM191, XM192, and XM193 series of ground illumination signals to determine their suitability for use by US Army units in the Republic of Vietnam. The signals were evaluated by the 1st Cavalry Division (AM), 101st Airborne Division (AM), Americal Division, and the 25th Infantry Division from 1 November to 31 December 1969 in regular combat operations. During the evaluation the signals were used for medical evacuation and resupply missions, identification of landing zones, and marking of unit positions. The conclusions of the evaluation were: (1) The signals were readily visible to aircraft at slant ranges greater than 1500 meters on a clear night; (2) Identification of the signal color and preparation for use under conditions of darkness was easy; (3) In most instances the burning times were sufficient for the signaling mission; (4) The signals were unreliable if thrown more than a few meters onto hard dirt surfaces; (5) Light weight and ready availability of the signals as a light source favored its acceptability; (6) The 2-to-5 second delay in the fuze functioning sequence was too brief to permit throwing the signal safely; (7) Evaluating organizations generally stated that the signals were suitable for use in RVN, if the impact durability and fuze design could be improved. It was recommended that the ground illumination signals not be procured in their evaluation configuration, but the design be modified to provide for incorporation of a positive safety device to prevent ignition until the signal is released from the user's hand, and for reliable ignition under impact conditions.

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	ROLE	WT	ROLE	WT	ROLE	WT
Ground Illumination Signal						
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XM192						
XM193						
Signal Illuminator						
Mini-grenade						